The effectiveness of mobile-health technologies to improve health care service delivery processes: a systematic review and meta-analysis

CRD summary
This review assessed interventions using mobile phones, Smartphones and other mobile technologies to support delivery of healthcare. The authors concluded that healthcare provider-support interventions generally showed a small benefit. Text message appointment reminders also showed modest benefits. The authors’ conclusions reflect the limitations of the evidence base and seem appropriate.

Authors' objectives
To assess the effects of mobile technology-based interventions delivered to health care providers, or to support health care services, on health and health care service outcomes.

Searching
The authors searched nine bibliographic databases (including MEDLINE, EMBASE, PsycINFO and The Cochrane Library) from 1990 up to September 2010. Search terms were reported. Reference lists of included trials were also searched. No language restrictions were imposed.

Study selection
Controlled trials that used any mobile technology intervention (mobile phones, Smartphones, and other technologies listed in the paper) to improve or promote health or health service use or quality were eligible for inclusion. Participants could be men or women of any age. Primary outcomes were defined as any objective measure of health, health service delivery or use. Secondary outcomes were self-reported outcomes related to health behaviour, disease management, health service delivery or use, or cognitive outcomes.

The included trials covered a wide range of technologies in interventions applied to: medical education; clinical diagnosis and management; communication to or between health care providers; appointment reminders; and notification of test results. Most trials were conducted in high-income countries (including two in the UK).

Two reviewers independently selected studies for inclusion.

Assessment of study quality
Quality was assessed by two reviewers independently based on Cochrane Collaboration criteria which covered sequence generation, allocation concealment, blinding of outcome assessors and data analysts, completeness of follow-up, selective outcome reporting, and other potential sources of bias. Discrepancies were resolved by discussion with a third reviewer.

Data extraction
Risk ratios or mean differences and associated 95% confidence intervals were extracted or calculated for included studies. Trial authors were contacted for additional information if required.

Two reviewers independently extracted data. Discrepancies were resolved by discussion with a third reviewer.

Methods of synthesis
Interventions were divided into those designed to support health care providers and those targeting communication between health services and consumers of health care. A narrative synthesis was presented under these main headings.

Pooled risk ratios for text message appointment reminders were calculated using a random-effects model. Heterogeneity was assessed visually from forest plots, and by using $X^2$ and $I^2$.

Risk of publication bias was assessed using funnel plots.
Results of the review
Forty-two trials were included: 32 trials of health care provider support (5,323 participants) and ten trials of interventions for communication between health services and consumers (4,473 participants). Eleven of the trials were non-randomised. None of the trials were at low risk of bias for all criteria or reported an objective clinical outcome.

Trials of health care provider support reported 25 outcomes related to disease management; 11 showed statistically significant benefits. Two trials reported statistically significant reductions in correct diagnoses using mobile technology photos compared with a reference standard.

Text message reminders significantly increased appointment attendance by 6% compared with no reminder (RR 1.06, 95% CI 1.05 to 1.07; I²=86%; 10 trials), but there was no significant effect for cancelled appointments and no difference between text message and other types of reminder.

There was no evidence of publication bias.

Authors’ conclusions
Results for health care provider support interventions generally suggested a small benefit, although two trials found reductions in correct diagnoses with mobile technology-based photos. Text message appointment reminders had modest benefits and may be appropriate for implementation. High quality trials reporting clinical outcomes were needed.

CRD commentary
The review question and inclusion criteria were broad but generally clear. The search covered a wide range of sources without language restrictions. Publication bias was assessed and no evidence of bias was found. Appropriate methods were used to minimise risk of reviewer errors or bias.

Study quality was assessed using standard criteria. Methods of synthesis seemed appropriate, with meta-analysis used where possible. The meta-analysis of text message reminders was dominated by a large non-randomised study and was subject to substantial heterogeneity, so the effect may be more uncertain than the narrow confidence interval would suggest.

Overall, this was a well-conducted review and the authors’ conclusions and research recommendations appropriately reflect the limitations of the evidence base.

Implications of the review for practice and research
Practice: The authors stated that health care providers should consider implementing text message appointment reminders because of the high cost of missed appointments and the low cost of reminders.

Research: The authors stated that trials were required to establish the effects of mobile health technologies on clinical outcomes. Trials in low- and middle-income countries were also required.

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